

XIII. NOTES ON CRUSTACEA DECAPODA
IN THE INDIAN MUSEUM.

IX. *LEANDER STYLIFERUS*, MILNE-EDWARDS, AND RELATED
FORMS.

(Plates VIII—X).

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of India.*

One of the most conspicuous features of the fauna of the silt-laden waterways of the Gangetic delta and other estuarine regions of the Indian coast is the enormous abundance of prawns belonging to the genus *Leander*. In general appearance the forms that frequent these localities differ widely from the marine species on which our conception of the genus is primarily based; the rostrum is much longer, with an elevated dentate crest at its proximal end, the second legs are very slender, often with the palm of the chela inflated, and the last three legs are attenuated. *Leander styliferus*, described by Milne-Edwards eighty years ago from specimens obtained at the mouth of the Ganges, is typical of the species that exhibit these characteristics.

The group of species, though it appears to be a natural one, is by no means clearly defined, for it grades almost imperceptibly into the more normally constituted elements of the genus, through such forms as *Leander concinnus*, de Man, and *L. indicus*, Heller. It is, however, of particular interest in the study of the brackish water fauna of Eastern Asia in that it includes a number of abundant species that migrate annually from the sea into estuaries and tidal rivers, as well as others that have succeeded in establishing themselves in pure fresh water.

Some of the forms are of considerable economic importance in India and China, and probably also in other countries. Vast quantities of *Leander styliferus* and *L. tenuipes* are caught in the Gangetic delta and sold in those markets frequented by the poorer classes of the population, while in the Kiangsu province of China *L. modestus* is captured in large numbers, especially in the Tai Hu Lake. To a European palate these species of *Leander* are lacking in flavour and seem greatly inferior to the Penaeidae that frequent the same waters.

Among the Carids that have been accumulating in the Indian Museum for the past thirty years, the species of *Leander* allied to *L. styliferus* are well represented and the collection has recently been enriched by the acquisition of a number of specimens, comprising several forms of great interest, obtained by Dr. Annandale in China and in the Malay Peninsula.

Including the new forms described below, ten species showing affinity with *L. styliferus* are now known; seven of these are dealt with in detail below. I have added an account of a very remarkable allied form which occurs in great abundance in Indian estuaries in company with *Leander*. According to the methods at present in vogue this species must be referred to the genus *Palaemon*, but it bears such an exceedingly close resemblance to *L. styliferus* that it may be doubted whether there is not some error in our scheme of classification. I have called this species *Palaemon mirabilis*.

The principal characters of *Leander styliferus* and the related species may be expressed in the following way:—

- I. Dactylus of last three peraeopods very long and slender, that of fourth and fifth pairs at least as long as propodus; pleopods very long, those of first pair much longer than carapace [carapace with branchiostegal spine; palm of second peraeopods much swollen].
 - A. Last two pairs of peraeopods excessively long, flagelliform, with dactylus much longer than carapace; carpus of second peraeopods much more than half as long as palm.
 1. Basal crest of rostrum with at most 7 teeth; fingers of second peraeopod more than twice as long as carpus ... *tenuipes*,
Henderson.
 2. Basal crest of rostrum with 8 teeth; fingers of second peraeopod twice or less than twice as long as carpus ... *hastatus*,
Aurivillius.¹
 - B. Last two pairs of peraeopods not excessively long, dactylus much shorter than carapace; carpus of second peraeopods less than half the length of palm *annandalei*,
sp. nov.
- II. Dactylus of last three peraeopods not abnormal in length, shorter than propodus; pleopods normal in length, those of first pair shorter than carapace.
 - A. Carapace with branchiostegal spine; carpus of second peraeopods less than one and a half times as long as chela.
 1. Palm of second peraeopods much swollen in large specimens, carpus much shorter than chela.
 - a. One or more subapical dorsal teeth on rostrum; carpus of second peraeopods shorter than merus or than fingers; last abdominal somite in adults not more than half length of carapace.
 - i. Dactylus of third peraeopod more than three quarters length of propodus, that of fifth peraeopod nearly half length of propodus; last four abdominal somites sharply carinate dorsally *carinatus*,
Ortmann.
 - ii. Dactylus of third peraeopod scarcely half length of propodus, that of fifth peraeopod at most one third length of propodus;

¹ I have not seen specimens of this species.

- last four abdominal somites at most very bluntly carinate dorsally *styliiferus*,
 b. No subapical dorsal tooth on rostrum; carpus of second peraeopods as long as merus or fingers; last abdominal somite nearly two thirds as long as carapace Milne-Edwards.
2. Palm of second peraeopods little if at all swollen, carpus at most only a trifle shorter than chela [at most 5 teeth on lower border of rostrum].
- a. One or two small subapical dorsal teeth on rostrum *mani*, Sollaud.¹
- b. No subapical dorsal teeth on rostrum *modestus*, Heller.
- B. Carapace without branchiostegal spine; carpus of second peraeopods at least one and a half times as long as chela.
1. Rostrum shorter, with 3 to 5 inferior teeth; last three peraeopods shorter, fifth pair extending beyond antennal scale by little more than length of dactylus *fluminicola*,
 sp. nov.
2. Rostrum longer, with 6 to 10 inferior teeth; last three peraeopods longer, fifth pair extending beyond antennal scale by dactylus and at least one half of propodus *potamiscus*,
 sp. nov.

These species form, I believe, a natural group, though some of them possess very unusual characters. *Leander tenuipes*, together with a related but imperfectly known W. African species, described by Aurivillius as *L. hastatus*, exhibits in the excessive length and slenderness of the last three thoracic legs a feature paralleled among *Macrura* only in the deep-sea Nematocarcinidae.² A link between these species and more normal types is, however, afforded by *L. annandalei*, a most interesting form obtained by Dr. Annandale near Shanghai.

The two last species mentioned in the key differ, so far as I am aware, from all described representatives of the genus in the complete absence of the branchiostegal spine. This character might, indeed, be held to possess generic value; but the spine in question is not infrequently very small in other species of *Leander* and the affinities of the forms in which it is absent appear to be unmistakably with the more normally constituted *L. mani* and *L. modestus*.

Of the seven species that I have myself examined, *L. styliiferus* and *L. tenuipes* are apparently seasonal immigrants to brackish water, ascending estuaries and tidal rivers, possibly for breeding purposes, when the monsoon floods are abating. The two species

¹ I have not seen specimens of this species.

² In the Nematocarcinidae, however, the extreme length of the legs is due to the lengthening of the merus, ischium and carpus, whereas in *Leander tenuipes* and its ally the merus and ischium are nearly normal in length and the carpus quite short, the propodus and dactylus being the segments that are attenuated.

are often found together. *L. potamiscus* has been found only three times, on each occasion in water that was fresh but subject at times to tidal influence: *L. annandalei* and *L. modestus* appear to be inhabitants of pure fresh water. The most remarkable species from the point of view of habitat is *L. fluminicola*, which although occasionally taken in water of slight salinity, also occurs in rivers far above tidal influence and has even been found at Mirzapur in the United Provinces at a distance of fully 700 miles by river from the coast.

All the species here referred to the genus *Leander* possess a mandibular palp of three segments. The maxillae and maxillipedes are remarkably uniform in structure, differing little if at all from those of *L. serratus* (Pennant).

Leander tenuipes, Henderson.

(Plate viii, fig. 1.)

1893. *Leander tenuipes*, Henderson, *Trans. Linn. Soc., Zool.* (2), V, p. 440, pl. xl, figs. 14, 15.

1903. *Leander tenuipes*, Nobili, *Boll. Mus. Torino*, XVIII, no. 452, p. 7.

The rostrum is variable in length, extending beyond the apex of the antennal scale by a proportion varying from one fifth to nearly one half of its length. The basal crest is well elevated and bears from 5 to 7 teeth,¹ of which from 2 to 4 are situated on the carapace behind the orbit. The teeth increase in size from behind forwards, the hindmost being as a rule quite rudimentary. The foremost tooth of the series does not reach the end of the first segment of the antennular peduncle. In front of the basal crest, the rostrum trends downwards, but before reaching the end of the antennular peduncle is reflected strongly upwards and is continued almost in a straight line from this point to the apex. On the dorsal edge near the tip there is, almost without exception, a single tooth. The lower margin is provided with from 2 to 6 teeth, nearly always 4 or 5²; the teeth are small and widely spaced and the proximal one is well in advance of the foremost of those that constitute the basal crest (pl. viii, fig. 1).

The anteunal and branchiostegal spines are about equal in length; the latter is flanked by a short carina and is placed on the extreme frontal margin of the carapace, *not* a little distance behind it as in some other species of the genus. In the eyes the breadth of the cornea is about equal to the length of the stalk; there is no visible ocellus.

The spine forming the lateral process of the basal antennular segment is very inconspicuous. The second peduncular segment, measured dorsally, is exceedingly short, much less than half the length of the third. The short ramus of the outer antennular

¹ Of 42 specimens, eight have 5 teeth on the basal crest, twenty-one have 6 teeth and thirteen have 7 teeth.

² Of 42 specimens, two have 2 inferior teeth, three have 3 teeth, sixteen have 4 teeth, nineteen have 5 teeth and two have 6 teeth.

flagellum reaches barely to the apex of the antennal scale; it is fused with its fellow for some 7 or 8 segments, the fused portion being about two fifths the length of the entire shorter ramus and a little less than the length of the ultimate peduncular segment. The basal portion of the inner flagellum is swollen. The antennal scale is rather strongly narrowed anteriorly; its length is about three and a third times its greatest breadth and the distal portion of the lamella extends far beyond the spine that terminates the outer margin.

The oral appendages and maxillipedes do not differ markedly from those of *L. serratus*. The mandibular palp is composed of three segments, of which the third is scarcely longer than the second. The anterior lobe of the epipod of the first maxillipede is not pointed as in Sollaud's *L. mani*. The antepenultimate segment of the third maxillipede is considerably expanded distally, the exopod reaching only a little beyond the middle of its length. The ultimate segment is only about one eighth shorter than the penultimate.

The first peraeopods reach a little beyond the apex of the antennal scale. The carpus is a trifle shorter than the merus and is about one and a half times the length of the chela. The fingers are fully one and a half times the length of the palm.

The second peraeopods in most cases reach beyond the antennal scale by at least the length of the chela, sometimes by that of the chela, carpus and a small portion of the merus. Measurements (in mm.) of the separate segments in seven specimens are as follows:—

Serial Number.	Locality.	Sex.	Total length. ¹	Length of carapace & rostrum.	Length of carapace. ²	Total length of 2nd leg. ³	2nd Peraeopod: length of				
							Ischium.	Merus.	Carpus.	Palm.	Dactylus.
1	Chennai, Gangetic delta.	♀ ovig.	63	27.2	12.5	34.7	4.4	11.3	4.0	5.0	8.9
2		♀ ovig.	62	26.1	12.0	34.2	4.4	11.4	3.4	4.5	9.1
3		♀ ovig.	60	27.3	10.4	30.0	4.0	10.2	2.8	4.0	8.4
4	Port Canning, Gangetic delta.	♀	65	28.4	12.2	31.9	4.4	10.0	3.2	4.2	8.0
5		♂	63	28.8	10.9	31.0	4.2	10.2	2.5	3.5	8.4
6		♂	61	26.0	11.1	28.3	3.6	9.3	2.5	3.7	7.8
7	Green I., Amherst, Tennasserim.	♂	56	23.2	11.0	31.0	4.1	10.6	2.8	3.6	8.0

¹ Measured from the tip of the rostrum to the tip of the telson, with the animal extended as nearly as possible in a straight line.

² Measured from the back of the orbit to the posterior mid-dorsal point.

³ Measured from the basis to the tip of the fingers.

It will be noticed that the merus is the longest segment and that the carpus is distinctly shorter than the palm and is less than half the length of the fingers. The palm is strongly swollen and the fingers are straight with conspicuously inturred tips that cross one another when the claw is closed.

The last three legs are of extraordinary length and slenderness and are usually found broken in preserved material. In a few individuals in which they are present they yield the following measurements (in mm.):—

Serial Number, ¹		Sex.	Length of				
			Ischium.	Merus.	Carpus.	Propodus.	Dactylus.
4	} Third peraeopod ... {	♀	4.3	8.9	3.2	9.1	4.7+
7		♂	3.9	7.9	2.8	8.0	11.4+
2	} Fourth peraeopod ... {	♀ ovig.	5.5	9.7	3.1	17.7	36.8+
4		♀	5.5	9.3	3.4	17.9	34.5+
1	} Fifth peraeopod ... {	♀ ovig.	6.1	8.7	3.8	17.4	...
3		♀ ovig.	5.5	7.3	3.2	17.9	28.3+
4		♀	5.8	7.9	3.2	17.8	36.6+
7		♂	5.0	7.3	3.0	16.3	37.5+

The extreme length of these legs² is due in the main to the lengthening of the propodus and dactylus; the carpus in all cases is quite short. The third legs are at least two thirds the entire length of the animal; the fourth and fifth pairs are much longer, considerably exceeding the total length. The dactylus is broken in all the specimens examined; when complete it is evidently much longer than the combined lengths of the rostrum and carapace and more than twice the length of the propodus. Henderson notes that the dactylus of the last legs (in a specimen measuring 55 mm. from the orbit to the apex of the telson), though broken at the tip, was 45 mm. in length.

Except for the first pair the peraeopods are entirely devoid of hairs.

¹ The specimens measured are the same as some of those in the table previously given. The serial numbers afford individual reference.

² I understand that the figures illustrating Dr. Henderson's valuable "Contribution to Indian Carcinology" were not drawn under the author's supervision, but were executed after his return to India. In the figure of *L. tenuipes* the proportions of the segments of the last three legs are wholly erroneous.

The abdomen, though compressed, is not dorsally carinate. The pleura of the fifth somite are narrowed and drawn out posteriorly. The sixth somite, measured dorsally, is a trifle more than half the length of the carapace. The pleopods are exceptionally long, those of the first pair being about one and a half times the length of the carapace.

The telson reaches only a little beyond the middle of the outer uropod. It is rounded above and sometimes bears a pair of small spinules near the distal end. The apex, when perfect, is seen to bear a single pair of lateral spinules which extend considerably beyond the rounded median prominence. The outer uropod is long and narrow; its outer margin in front of the sub-terminal spine is distinctly concave.

Large specimens of *L. tenuipes* reach a total length of 65 or 70 mm. The eggs are small, about 0.55 mm. in length and 0.44 mm. in breadth.

In examples from 15 to 30 mm. in length the rostrum is very much shorter than in adults, not reaching beyond the middle of the last segment of the antennular peduncle and with at most only faint traces of teeth on the lower margin. The last abdominal somite is proportionately much longer, being scarcely shorter than the carapace in the smallest examples. In a specimen only 22 mm. in length the second peraeopods already closely resemble those of adults, reaching beyond the antennal scale by almost the entire length of the chela. The great length of the last three legs is a conspicuous feature even in the smallest individuals.

Leander tenuipes is evidently a very close ally of *L. hastatus* (Aurivillius)¹ from the Cameroons. Aurivillius does not refer in his description to the great length and slenderness of the last three pairs of peraeopods, but it is clear from his figure that the species possesses this character. A further examination of West African specimens is necessary before the distinctions between *L. hastatus* and *L. tenuipes* can accurately be determined. The African species appears to differ in having 8 teeth on the basal crest of the rostrum, in the shorter fingers of the second legs which are usually less than twice the length of the carpus, and in the greater length of the sixth abdominal somite which is fully two thirds as long as the carapace. According to Aurivillius' measurements the segments of the second peraeopods show far greater variation in length than in *L. tenuipes*.

Living specimens of *L. tenuipes* are for the most part translucent with a slightly milky tinge. In adults the mandibular region is bright red and the rostrum is dotted with carmine. The lower antennular flagellum is carmine at the base changing to deep mauve nearer the tip. There are a few very small red chromatophores on the segments of the large chelipede. On either side of the abdomen there are red flecks at the points where the somites

¹ *Palaemon (Leander) hastatus*, Aurivillius, *Bihang till K. Svenska Vet.-Akad. Handl.*, XXIV, Afd. iv, no. 1, p. 27, pl. iv, figs. 3-6.

are hinged and there are also small red chromatophores on the pleura and dorsally at the distal ends of the last three segments. The lateral margins of the telson and the outer edge of the external uropod are deeply stained with red; on the internal uropod there are scattered red chromatophores. The eggs are bright gamboge yellow. Very young individuals are almost wholly transparent.

In specimens kept alive in an aquarium it was found that the ischial and meral segments of the last three legs were held forwards, downwards and a little outwards. The filiform terminal segments were trailed from the distal end of the merus in much the same manner as if the lash of a whip were drawn through the water from the end of a stiff handle. The legs were evidently not used in progression and it may be surmised that they have taken on a sensory function.

The specimens examined are from the following localities:—

$\frac{3271.2}{7}$	Madras	Purchased.	Several.
$\frac{167.90}{7}$	Tanda, about 30 miles S. of Coconada, 4-5 fms.	'Investigator.'	Several.
$\frac{1171}{7}$	4 miles off Vizagapatam Coast, Madras Pres., 7½-9½ fms.	'Investigator.'	One.
$\frac{9152}{10}$	} Puri, Orissa Coast (from fishermen's nets)	T. Southwell, S. Kemp.	Many.
$\frac{9723}{10}$			
$\frac{3148.56}{7}$	} Gangetic delta (many localities)	A. J. Milner, R. Munro, W. T. Blanford, J. Wood-Mason, J. T. Jenkins, T. Southwell, S. Kemp.	} Many.
$\frac{9515.21}{10}$			
$\frac{9717.22}{10}$			
$\frac{9522}{10}$	Mouth of Rangoon R., Burma	'Investigator.'	Three.
$\frac{9523}{10}$	Moulmein R., Burma	"	One.
$\frac{9524}{10}$	Bassein R. Estuary, Burma	"	Two.
$\frac{9514}{10}$	Green I., Amherst, Tennasserim	"	Several.

In addition there are a large number of specimens, unquestionably belonging to *L. tenuipes*, labelled "Lyttleton Harbour, New Zealand; W. Guyes Brittan." I can find no reason to distrust the label, but the record seems to require verification before such a great increase in the range of the species can be accepted.

Leander tenuipes was described by Henderson from the Gulf of Martaban and Madras and has since been recorded by Nobili from Bombay. It is frequently found in company with *L. styliiferus* and has occasionally been caught in surface nets near the shore. Though often taken in the open sea, it is evidently far from uncommon in brackish water, probably migrating to estuaries and up rivers at the close of the monsoon. I am not aware that it has even been found in pure fresh water.

***Leander annandalei*, sp. nov.**

When describing *L. tenuipes*, Henderson noted that the species was so peculiar in character that he was at one time inclined to create a new genus for its reception. The new form obtained by Dr. Annandale in China is proof that he was wise in adopting a

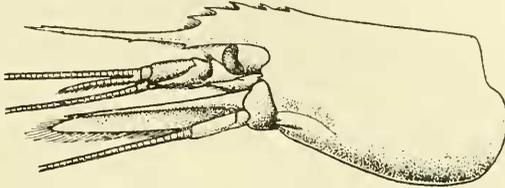


FIG. 1.—*Leander annandalei*, sp. nov.
Carapace, rostrum, etc., in lateral view.

conservative policy : it forms a link between Henderson's species and more normal members of the genus and affords most interesting evidence of the manner in which such an extreme type as *L. tenuipes* has been evolved.

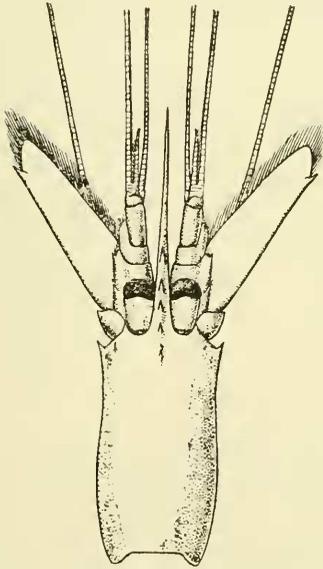


FIG. 2.—*Leander annandalei*, sp.
nov.
Carapace, rostrum, etc., in dorsal
view.

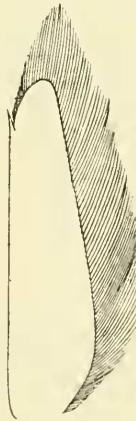


FIG. 3.—*Leander annandalei*,
sp. nov.
Antennal scale.

Unfortunately only a single specimen of *L. annandalei* was obtained.

The rostrum is similar to that of *L. tenuipes*, but is shorter, reaching beyond the antennal scale by only about one tenth of its

length; the distal portion trends only a little upwards. The basal crest bears 5 equally separated teeth, increasing in size from behind forwards; the hindmost alone is situated on the carapace behind the orbit and the foremost is placed over the articulation between the first and second segments of the antennular peduncle (text-fig. 1). There is a single small sub-terminal dorsal tooth and four small, widely separated teeth on the lower margin.

The branchiostegal spine is fully as large as the antennal; it is situated a little behind the frontal margin, thus differing from *L. tenuipes*. The eyes resemble those of the allied species, the stalk being proportionately a trifle larger. The antennular peduncle does not show any marked peculiarities; the second segment is very short (text-fig. 2). The shorter ramus of the outer flagellum is nearly as long as the peduncle; it is fused basally with its fellow for a distance not greater than one third the dorsal length of the ultimate peduncular segment. The antennal scale is narrowed anteriorly and is a trifle more than four times as long as broad (text-fig. 3).

The oral appendages resemble those of *L. tenuipes*; the mandibular palp is composed of three segments.

The pereiopods differ conspicuously in their proportions from those of all other known species. The measurements of the separate segments (in mm.) are as follows:—

	Ischium.	Merus.	Carpus.	Propodus.	Palm.	Dactylus.
First pereiopod ...	2.2	3.1	2.8	...	0.7	0.6
Second	3.6	3.1	0.7	...	1.8	4.0
Third	3.6	3.7	0.4	1.9	...	1.1+
Fourth	3.8	3.9	0.6	3.0	...	5.2
Fifth	3.1	3.2	1.0	3.4	...	3.4

It will be noticed that in all the last four pairs of pereiopods the carpus is exceedingly short. In the second legs (text-fig. 4c), which reach beyond the antennal scale by about half the length of the fingers, this feature is specially remarkable, the segment being conical, little longer than broad, recalling that of certain species of the Pontoniid section of the Palaemonidae. In this limb, also, the ischium is conspicuously longer than the merus, resembling in this respect *L. styliferus*, rather than *L. tenuipes*. The dactylus of the third pereiopod (text-fig. 4d) is incomplete; in the fourth pair (text-fig. 4e) it is longer than the propodus, while in the fifth pair (text-fig. 4f) the two terminal segments are of equal length. Very long hairs are to be found on the ischium and merus of the first, third and fourth pairs; otherwise the limbs are glabrous or with

a few short and fine hairs. The dactylus of the last pair has a slight swelling at the base which is rather thickly clothed with short hairs.

The abdomen is much compressed laterally, but is not carinate. The sixth somite, measured dorsally, is fully two thirds as long as the carapace. The pleopods, as in *L. tenuipes*, are very long, those of the first pair being nearly one and a half times the length of the carapace. The telson is rounded above and bears a single pair of dorsal spinules near the distal end. The apex is minutely pointed in the middle with a long lateral spinule on either side.

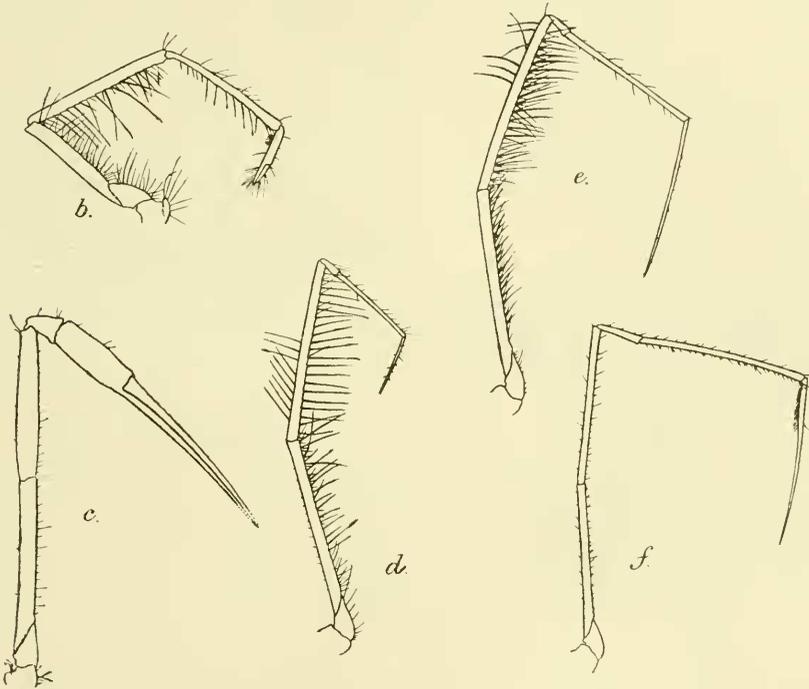


FIG. 4.—*Leander annandalei*, sp. nov.

b. First peraeopod.

d. Third peraeopod.

c. Second peraeopod.

e. Fourth peraeopod.

f. Fifth peraeopod.

The single specimen of this interesting species is a female, without eggs. The rostrum and carapace together measure about 14 mm., the carapace alone being about 6.5 mm. Owing to the fact that the specimen is strongly bent it is difficult to measure the total length in a satisfactory manner; it would probably be about 32 or 33 mm. when the animal was extended.

The type specimen (no. 9758/10, *Zool. Surv. Ind.*) was dredged by Dr. Annandale in China, in the Whangpoo River between Shanghai and Woosung, at a depth of $5\frac{1}{2}$ to $7\frac{1}{2}$ metres. It was obtained in water that was quite fresh.

Leander styliferus (Milne-Edwards).

(Plate viii, fig. 2.)

1837. *Palaemon longirostris*, Milne-Edwards, *Hist. Nat. Crust.*, II, p. 394.
 1840. *Palaemon styliferus*, Milne-Edwards, *ibid.*, III (errata), p. 638.
 1893. *Leander longirostris*, Henderson, *Trans. Linn. Soc.* (2), V, p. 439.
 1902. *Palaemon styliferus*, Rathbun, *Proc. U. S. Nat. Mus.*, XXVI, p. 51.
 1903. *Leander longirostris*, Nobili, *Boll. Mus. Torino*, XVIII, no. 452, p. 7.
 1908. *Leander* sp., de Man, *Rec. Ind. Mus.*, II, p. 220, pl. xviii, fig. 3.
 1915. *Leander styliferus*, Kemp, *Mem. Ind. Mus.*, V, p. 273.

The rostrum is long, reaching beyond the apex of the antennal scale by a distance varying from one third to three fifths of its length. The proximal portion is strongly elevated dorsally forming a well-marked basal crest which bears from 5 to 7 (usually 6)¹ procurved teeth. The teeth increase in size from behind forwards; the hindmost is frequently situated on the carapace behind the level of the orbit and the foremost reaches little if at all beyond the end of the first segment of the antennular peduncle. In front of the basal crest the rostrum is slender and up-turned; for the greater part of its length it is usually unarmed, but near the tip is as a rule provided with from 1 to 3² small widely separated teeth. The lower margin bears from 6 to 10 teeth (usually 7, 8 or 9)³; the proximal teeth are generally rather closer together than the distal and the hindmost is usually situated a little behind or a little in front of the foremost tooth of the basal crest (pl. viii, fig. 2).

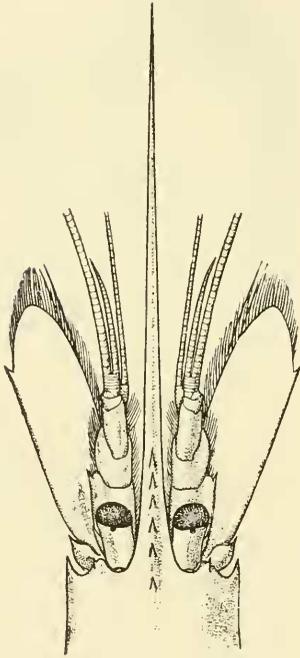


FIG. 5.—*Leander styliferus*, Milne-Edwards.
 Carapace, rostrum, etc., in dorsal view.

The carapace bears a small and inconspicuous antennal spine; the branchiostegal is much larger, situated on the frontal margin and is flanked by a short and blunt carina. Above the branchio-

¹ Of forty specimens thirteen have 5 basal teeth, twenty-three have 6 and four have 7.

² I have seen one specimen without any teeth on the distal part of the upper margin, one with 4 teeth and one with 5.

³ Of forty specimens two have 6 inferior teeth, fourteen have 7, twelve have 8, eight have 9 and four have 10. I have seen single examples with 5 and 11 teeth and Nobili records specimens, one from Bombay and one from Borneo, with 12 and 13 inferior teeth.

stegal spine there is a finely cut groove, resembling a suture line, which extends from the anterior margin backwards for about one third the length of the carapace.

The greatest breadth of the cornea is about equal to the length of the eyestalk. A small ocellus (not found in either of the two preceding species) is visible, partly joined to the cornea (text-fig. 5).

The basal segment of the antennular peduncle bears a small spine on the lower surface near the middle of its internal margin. The outer border, in front of the short spine representing the lateral process, is sinuous and terminates in a tooth which extends but little beyond the level of the protruding, setose antero-external margin of the segment. The second segment, measured mid-dorsally, is a little more than half the length of the third. The total length of the shorter branch of the outer antennular flagellum is about equal to that of the peduncle; sometimes it is a little longer, sometimes shorter. The length of the fused portion is variable, even on the two sides of the same specimen; it consists of some 8 to 12 segments and is as a rule decidedly shorter than the last peduncular segment.

The antennal scale differs considerably from that of the two preceding species. It is broader, scarcely three times as long as wide, and the rather sharply rounded distal end of the lamella extends much further beyond the spine that terminates the outer margin.

The oral appendages do not differ in any noteworthy degree from those of *L. serratus*, Pennant. The mandibular palp is composed of three segments, the ultimate almost twice the length of the penultimate. The third maxillipedes reach about to the end of the antennal peduncle; the antepenultimate segment is less expanded distally than in *L. tenuipes* and the exopod reaches to its anterior quarter; the last segment is about two thirds the length of that which precedes it.

The first peraeopods reach almost or quite to the end of the antennal scale. The merus and carpus are about equal; the chela is barely three fifths the length of the carpus and the fingers are only a trifle longer than the palm.

The second peraeopods vary considerably in length. In large specimens of both sexes they may extend beyond the tip of the scale by the whole of the chela, carpus and a small portion of the merus; in others, also fully adult, they reach beyond the same point only by the length of the chela, in others again only by a small fraction of the finger-length. The proportions of the segments in ten large individuals are shown in the table on p. 216.

It will be noticed that the ischium, merus, carpus and palm decrease successively in length in nearly all cases, but that in very large males the carpus is sometimes equal to, or a little longer than the merus. The fingers are either a little shorter than, equal to, or longer than the ischium; the carpus in all cases is very

much shorter than the entire chela, often only about half its length. In specimens in which the limb is very long the characteristic swollen condition of the palm is most obvious, the tips of the fingers being strongly incurved and crossing each other when the claw is closed. In examples in which the limb is proportionately shorter the palm is less strongly swollen and the tips of the fingers are little, if at all, inturred.

The last three pairs of legs are slender and usually bear short setae on the posterior margins of the ischium, merus, carpus and propodus. Those of the third pair reach to, or a little beyond the middle of the antennal scale; those of the fifth pair are longer, usually reaching beyond the scale by part or all the length of the

Locality.	Sex.	Total length.	Length of carapace & rostrum.	Length of carapace.	Length of 2nd leg.	2nd Peraeopod: length of				
						Ischium.	Merus.	Carpus.	Palm.	Dactylus.
Port Canning, Gangetic delta.	♂	88	39.5	18.0	67.3	14.8	12.4	12.9	9.4	14.5
	♂	79	37.0	14.4	53.3	11.7	9.6	10.2	6.9	11.5
Off Cowcolly Lighthouse, Gangetic delta.	♀ ovig.	91	44.5	17.3	49.7	12.1	10.5	9.1	7.2	11.3
	♀ ovig.	87	41.7	17.9	34.9	8.0	7.5	5.8	4.6	7.2
Hog I., Bombay.	♂	94	50.0	16.0	48.3	11.0	10.0	9.3	7.3	11.0
Bombay.	♂	96	47.8	17.9	53.7	11.7	10.1	10.1	8.7	11.0
Keti, Karachi dist.	♀ ovig.	84	44.6	15.0	29.9	6.3	5.9	4.5	3.7	7.1
	♀ ovig.	79	39.7	13.7	24.8	5.3	5.0	3.9	2.8	4.6
Green I., Amherst, Tennasserim.	♂	81	36.8	16.6	57.4	12.4	11.3	10.3	8.7	12.4
	♂	79	36.7	15.5	53.1	11.9	10.5	10.0	7.5	11.7

dactylus. The dactylus is slender and styliform; in the third pair it is rather less than one half the length of the propodus (text-fig. 6a). In the fifth pair it is from one third to one quarter the length of the propodus, being shortest in very large specimens (text-fig. 6b).

The abdomen is smoothly rounded above in small examples, but in those of large size sometimes bears a blunt and inconspicuous dorsal ridge extending from the middle of the third somite to the end of the sixth. The sixth somite, measured dorsally, is rather less than one half the length of the carapace.

The telson reaches to about three quarters the length of the outer uropod; it is not sulcate dorsally and usually bears two pairs

of minute or semi-obsolete spinules in its distal half. The apex in large specimens is simply pointed, without trace of lateral spinules; in smaller but still adult individuals two pairs of very small spinules may be found, not reaching the tip. The outer uropod is narrow, about three times as long as broad, with the external margin in front of the subterminal tooth almost straight.

Large individuals reach a length of a little over 100 mm.; the eggs are a trifle larger than in *L. tenuipes*, from 0.65 to 0.82 mm. in length and from 0.56 to 0.61 mm. in breadth.

As regards young specimens it may be noted that the second legs are very long, extending beyond the scale by the chela and practically the whole length of the carpus in an individual less than 60 mm. in total length; this precocious development seems, however, to be unusual. A series of very small specimens from Chittagong indicates clearly that those described by de Man in 1908 as *Leander* sp., belong to this species. In individuals about 30 mm. in total length the general appearance is closely similar to that of adults; the rostrum, however, has a less elevated basal crest and is shorter, reaching beyond the antennal scale by at most one quarter its length; the second legs do not as a rule exceed the scale by more than half the length of the fingers. In still smaller examples between 15 and 20 mm. in length, the rostrum is even shorter, sometimes not reaching the end of the scale; it usually bears only a single subterminal dorsal tooth and a reduced number of teeth (from 3 to 6) on the lower border. The second legs reach little, if at all beyond the scale; the palm is as long or even a little longer than the carpus and the fingers are shorter than in adults, being indeed in very small examples only as long as the palm. The sixth abdominal somite is a little more than half the length of the carapace. The telson tip, in specimens of 30 mm. in length and under, bears two pairs of lateral spinules, the inner pair very long and far exceeding the apex.

Living specimens are translucent with a faint milky tinge. The lower antennular flagellum, which is deeply pigmented in *L. tenuipes*, is quite colourless. The dark gastric mass is frequently visible through the carapace and often the tip of the rostrum and the extremities of the telson and uropods are suffused with red.

This species was known to earlier authors as "*Leander longirostris*, Say." Miss Rathbun has pointed out that Say never described a species under such a name, the confusion having arisen from misplaced footnote references in Milne-Edwards' treatise. The latter author described two separate species as "*Palemon*" *longirostris*, but suggested the name *styliferus* for the present form in the errata at the end of vol. III.

The specimens from Amoy, recorded by de Man¹ as *L. longirostris*, Say, have since been referred by that author² to *L. longipes*, Ortman.

¹ De Man, *Notes Leyden Mus.*, III, p. 141 (1881).

² De Man, *Trans. Linn. Soc. Zool.* (2), IX, p. 409 (1907).

Leander styliferus is closely related to *L. carinatus*, Ortmann; the distinctions between the two species are enumerated below. *L. japonicus*, Ortmann, which I have not seen, is an allied species, but according to Miss Rathbun (*loc. cit.*, 1902, p. 51) is to be distinguished by the absence of dorsal spines on the distal part of the rostrum, by the lower number of inferior teeth (4 to 6), by the greater length of the sixth abdominal somite and by the longer carpus of the second paeopods.

The specimens of *Leander styliferus* in the Indian Museum are from the following localities:—

$\frac{3241-50}{7}$	Keti, Karachi Dist., on the Hajamro branch of R. Indus.	Karachi Mus.	Many.
$\frac{1688-9}{9}$	Bombay	Purchased.	Two.
$\frac{1604}{7}$	Hog I., Bombay	'Investigator.'	One.
$\frac{9526}{10}$	Chilka Lake, Orissa coast	Mus. staff.	One.
$\frac{3412}{5}$	} Gangetic delta (many lo- calities).	} W. T. Blanford, J. } Wood-Mason, J. T. } Jenkins, R. Munro, T. } Southwell, S. Kemp. }	} Many.
$\frac{9532-51}{10}$			
$\frac{9727-9}{10}$			
$\frac{9527}{10}$	Chittagong (edge of river)	N. Annandale, S. Kemp.	Many young.
$\frac{7721}{6}$	Mouth of Yé R., Burma	'Investigator.'	Two.
$\frac{9528}{10}$	Mouth of Rangoon R., Burma	'Investigator.'	Several young.
$\frac{9529}{10}$	Rangoon market	N. Annandale.	Many.
$\frac{9530}{10}$	Haingyi I., Tennasserim	'Investigator.'	One.
$\frac{9531}{10}$	Green I., Amherst, Ten- nasserim	'Investigator.'	Several.
$\frac{9278}{6}$	Mergui	J. Anderson.	Two.

Specimens from the west coast of India as a rule have the rostrum markedly longer than those from the Bay of Bengal.

The species was originally described by Milne-Edwards from "l'embouchure du Gange." It is recorded by Henderson from Karachi, the Gangetic delta, the Gulf of Martaban and Mergui. Miss Rathbun has also recorded it from Karachi, and Nobili has reported specimens from Bombay and a single individual from Borneo.

The species occurs in water that is both salt and brackish and has been found at Diamond Harbour in the Gangetic delta in a freshwater creek. As in the case of *L. tenuipes*, with which it is frequently found, the species is probably migratory, entering estuaries and tidal rivers at the close of the monsoon. Capt. R. Munro, to whom we are indebted for numerous specimens, notes that in 1912 at the mouth of the Hughli river "the first appearance of cold weather shrimps" was in August.

Leander carinatus, Ortmann.

1891. *Leander longirostris* var. *carinatus*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 521.

1902. *Leander carinatus*, Doflein, *Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss.*, XXI, p. 639, pl. iii, fig. 8.

1914. *Leander styliiferus* var. *carinatus*, Balss, *ibid.*, Suppl. Bd. II, Abh. 10, p. 57 (? part only).

Twenty-seven specimens from N. China, all of which are unfortunately in very poor condition, appear to belong to this species. *L. carinatus* was originally described by Ortmann in the briefest possible manner from a much mutilated specimen obtained in China and was regarded by its author as a variety of Milne-

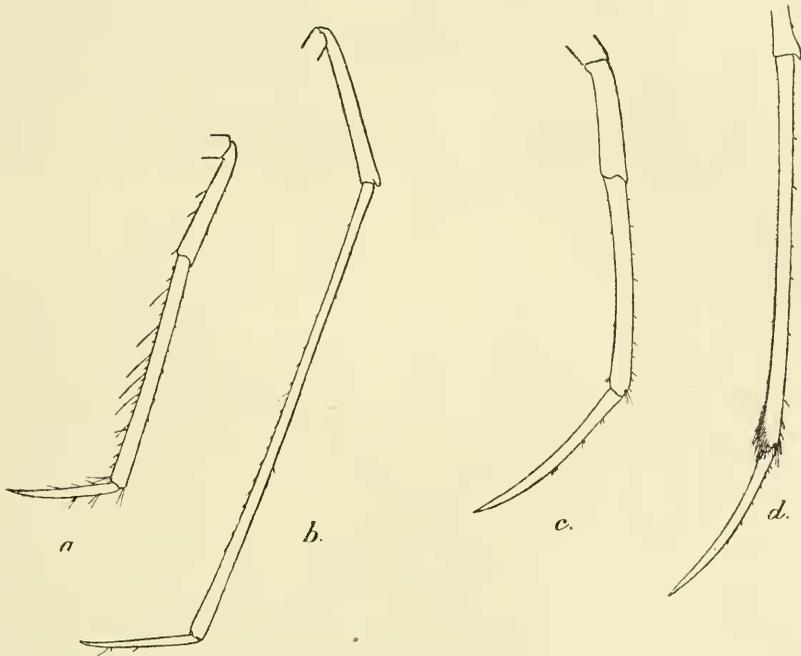


FIG. 6.—a, b. *Leander styliiferus*, Milne-Edwards.

c, d. *Leander carinatus*, Ortmann.

a, c. Third pereopod.

b, d. Fifth pereopod.

Edwards' *L. longirostris* (= *L. styliiferus*). If my identification is correct there can be no doubt that the form is specifically distinct, though closely related to *L. styliiferus*. *L. carinatus* may be distinguished by the following characters:—

(i) The basal crest of the rostrum bears from 6 to 9 (usually 7 or 8) teeth,¹ a number rather higher than is usual in *L. styliiferus*. The foremost of these teeth is much in advance of the hindmost tooth of the ventral series.

¹ Of twenty specimens one has 6 teeth on the basal crest, ten have 7 teeth, eight have 8 teeth and one has 9 teeth.

(ii) The fingers of the first peraeopods are a little longer, fully one and a half times the length of the palm.

(iii) The carpus of the second peraeopods is proportionately shorter; except in very large males it is shorter than the palm and little more than half the length of the fingers.

(iv) The dactyli of the last three peraeopods are proportionately much longer. In the third pair (text-fig. 6c) the propodus is only one and a fifth times and in the fifth pair (text-fig. 6d) only two and a fifth times as long as the dactylus.

(v) The last four abdominal somites are sharply carinate dorsally.

The rostrum is broken in all except two of the specimens. In these there are respectively 7 and 8 ventral teeth¹ and in both there appears to have been a single small subapical dorsal tooth.

Doflein appears not to have seen any fully developed males. In large examples of this sex the second peraeopods may reach beyond the antennal scale by the whole of the carpus and chela; the degree of development of these limbs is, however, as in *L. styliiferus*, subject to much variation. Five specimens yield the following measurements (in mm.):—

Sex.	Total length.	Length of carapace.	Length of 2nd peraeopod.	2nd Peraeopod: length of				
				Ischium.	Merus.	Carpus.	Palm.	Dactylus.
♂	77+	17.0	47	10.3	9.7	7.4	7.2	10.5
♂	71+	15.0	42	9.8	8.7	5.5	6.3	10.3
♂	76+	16.2	34	8.2	6.8	4.0	4.8	8.9
♂	85+	17.2	32	7.2	6.8	4.4	4.7	7.8
♀	?	14.0	25	5.4	5.3	3.3	3.7	6.1

The second peraeopods as a whole bear a close resemblance to those of *L. styliiferus*; in specimens in which the limb is relatively long the carpus is swollen at its distal end and the palm inflated. The proportionate length of the segments is variable, but the carpus appears always to be shorter than in the related species.

The best distinctive character is to be found in the great relative length of the dactylus of the last three pairs of peraeopods. In these limbs the length of the dactylus, compared with that of the propodus, is nearly twice as great as in *L. styliiferus* (text-fig. 6). The third peraeopods reach almost to the end of the antennular

¹ Ortman states that there are 5 ventral teeth and Doflein that there are 4 or 5. Balss has, however, remarked that the rostrum was incomplete in all the specimens seen by Doflein.

peduncle; the fifth are longer and sometimes extend to the tip of the antennal scale.

The dorsal carination of the last four abdominal somites—the chief character mentioned by Ortmann—is very conspicuous in all the specimens; it cannot be confounded with the low and very blunt dorsal ridge sometimes found in large examples of *L. styliiferus*.

The sixth abdominal somite, as in the related species, is less than half the length of the carapace. I have not found any differences in the telson or uropods.

The specimens, none of which are ovigerous, were obtained at Ningpo in China by Dr. B. Sing; they appear to have been found in brackish water.

Ortmann described the species from "China"; Doflein's specimens were from Tsingtau. The record by Balss from Singapore appears to me doubtful.¹

Leander modestus, Heller.

(Plate ix, fig. 1.)

1865. *Leander modestus*, Heller, *Reise 'Novara'-Exped., Crust.*, p. iii, pl. x, fig. 6.

The rostrum reaches beyond the antennal scale by at most one fifth of its length. The basal crest is strongly elevated and is furnished with from 8 to 10 evenly spaced teeth² of which one or two are situated on the carapace behind the orbit; the foremost of the series reaches to or beyond the articulation between the second and third segments of the antennular peduncle. In front of the basal crest the rostrum is straight or very slightly upturned, the upper margin being invariably unarmed. On the lower margin there are from 2 to 4 small teeth³ which are restricted to the middle third of the rostral length (pl. ix, fig. 1).

The branchiostegal spine is somewhat larger than the antennal and is situated on the frontal margin of the carapace. Above it there is a rather conspicuous longitudinal depression in which a finely-cut groove, similar to that found in the preceding species, may usually be detected.

The cornea of the eye is rather strongly swollen; a small ocellus is present.

The basal segment of the antennular peduncle is rather broad and bears the usual tooth on the inferior surface; the outer margin is convex, terminating in a spine which does not reach as far forward as the protruding setose antero-external portion of the

¹ Balss' record of *L. japonicus* from Hankow in China also seems to require confirmation.

² Of thirty-one specimens eight have 8 teeth on the basal crest, eighteen have 9 and five have 10.

³ Of thirty-one specimens three have 2 inferior teeth, twenty-four have 3 and four have 4.

segment. The second segment, measured dorsally, is shorter than the third. The accessory antennular ramus is shorter than the peduncle and is fused with its fellow for a length considerably less than that of the last peduncular segment, the fused portion consisting only of some 5 or 6 segments.

The antennal scale is broadly rounded apically, the lamella extending much beyond the spine that terminates the straight external margin. It is about three times as long as wide.

The mandibular palp is composed of three segments, the third nearly twice the length of the second. The third maxillipedes reach to the end of the antennal peduncle; the terminal segment is about two thirds the length of that which precedes it.

The first peraeopods reach the end of the antennular peduncle. The carpus is about one fifth longer than the merus and is a little more than twice the length of the chela; the fingers are longer than the palm.

The second peraeopods may reach beyond the tip of the antennal scale by nearly the whole length of the chela. The ischium is equal to or a little shorter than the merus and the carpus is between $1\frac{1}{3}$ and $1\frac{1}{5}$ times as long as the ischium. The chela is about equal to (sometimes a trifle shorter than, sometimes a trifle longer than) the carpus; the palm is not swollen as in the preceding species and is from one fifth to one tenth shorter than the fingers. The latter are straight with short, inturned corneous tips and are without teeth on the inner margin.

The last three pairs of peraeopods are slender; the third pair is the shortest, not quite reaching the end of the antennal scale; the fourth and fifth pairs are longer, extending beyond the scale by a portion of the length of the dactylus. In the third pair the propodus is less than twice the length of the carpus and is about one and a third times the length of the dactylus. In the fourth pair the propodus is longer, from two to two and a quarter times the length of the carpus, the dactylus being longer than the latter segment. In the fifth pair the dactylus is longer than the carpus and the carpus is about three sevenths the length of the propodus. The propodus of all three pairs is provided with a bunch of setae at its distal end and, in the case of the fifth pair, is thickly set with short hairs on the distal half of its inferior margin. The dactylus in each pair is without teeth, slightly curved, with some long setae on its upper border.

The abdomen is compressed but not carinate above. The sixth somite, measured dorsally, is rather more than half the length of the carapace. The pleopods are short, those of the first pair being shorter than the carapace.

The telson reaches to rather more than two thirds the length of the outer uropod. It bears two pairs of dorsal spinules distally; the apex is produced to a sharp point with two plumose setae beneath and two spinules on either side, the inner pair of the latter extending considerably beyond the tip. The outer uropod is about three times as long as broad. There is a movable

spinule on the inner side of the tooth that terminates the straight or slightly convex outer border.

Large specimens reach a length of about 60 mm. None of the females in the collection are ovigerous.

Young examples, from 15 to 25 mm. in total length, differ from adults in possessing a shorter rostrum, often not reaching beyond the end of the antennular peduncle and in the proportionately greater length of the sixth abdominal somite.

The colour of living specimens was translucent white, with sparsely scattered minute reddish-brown pigment cells, not arranged to form a definite pattern.

L. modestus is very closely related to *L. mani*, Sollaud,¹ from Tonkin, a freshwater species described as possessing large eggs. The most conspicuous character in which *L. modestus* differs from the southern Chinese form is the complete absence of teeth at the distal end of the upper border of the rostrum, a feature which is unquestionably of high specific value in other species of the same group of the genus. The first maxillipede differs from the figure given by Sollaud in the greater proportionate length of the basipodite, while the distal lobe of the epipod, though apically pointed, is not drawn out to the triangular process to which Sollaud has directed attention. The description of *L. mani* is preliminary; other distinctions will probably be found when the full account is published.

The specimens of *L. modestus* in the Indian Museum were all obtained by Dr. Annandale in China, in the neighbourhood of Shanghai. The species is common at the margins of the Tai Hu Lake, and is caught in large numbers in basket traps set among weeds. A few individuals were dredged from a bare muddy bottom in the middle of the lake and others were obtained in the Whangpoo River, between Shanghai and Woosung at depths of $5\frac{1}{2}$ to $7\frac{1}{2}$ metres. Young examples are common in ditches and ponds in the neighbourhood of Shanghai. All the specimens were obtained in pure fresh water.

The species was described by Heller from Shanghai in 1865, since which date it does not appear to have been recorded.

***Leander fluminicola*, sp. nov.**

(Plate ix, fig. 2.)

This species bears a close general resemblance to the preceding, differing from it only in the following particulars:—

(i) The rostrum exceeds the antennal scale by one sixth or one quarter of its length. The basal crest is less elevated and bears from 7 to 11 teeth (usually 8 or 9)² of which 1 or 2 are placed behind the level of the orbit. The distal part of the rostrum is

¹ Sollaud, *Bull. Soc. Zool. France*, XXXIX, p. 315, text-figs. (1914).

² Of forty specimens one has 7 teeth on the basal crest, twelve have 8, twenty-three have 9, three have 10 and one has 11.

more strongly upturned and is provided with one or two teeth on its upper edge near the tip¹ and sometimes with another between this point and the foremost tooth of the basal series. The lower margin bears from 3 to 5 teeth (usually 4),² which are spread out along its distal two-thirds and not restricted to the middle third as in *L. modestus* (pl. ix, fig. 2).

(ii) The branchiostegal tooth of the carapace is entirely absent.

(iii) The tooth that terminates the outer margin of the basal segment of the antennular peduncle extends much beyond the produced, setose, antero-external portion of the segment.

(iv) The accessory antennular ramus is very long, between one and a quarter and one and a half times the length of the peduncle.

(v) The antennal scale is a little more narrowed apically and is a trifle broader, less than three times as long as wide.

(vi) The first peraeopods reach a little beyond the end of the antennular peduncle; the carpus varies from two to nearly two and a half times the length of the chela.

(vii) The carpus of the second peraeopods is much longer, about one and a half times the length of either the ischium or the chela. The fingers are about as long as the palm. The chela is distinctly spooned in appearance; when viewed from its inner face the fingers are seen to be hollowed longitudinally, meeting only along their outer edges. When the chela is examined in dorsal and ventral views, the fixed finger and dactylus appear considerably broader near the apex than at their junction with the palm.

(viii) The last three pairs of peraeopods are very slender, but in their proportionate lengths similar to those of *L. modestus*. The dactylus in all three pairs is much shorter than the carpus, that of the fifth pair being scarcely half its length and only about one fifth the length of the propodus (*cf.* pl. ix, figs. 1 and 2). There are fewer hairs on the propodus of the fifth leg and the dactylus in all three pairs is without setae on its upper edge.

Large specimens reach a length of about 45 mm. The eggs are numerous and are comparatively small, from 0.74 to 0.87 mm. in length and from 0.57 to 0.65 mm. in breadth.

The species resembles *L. mani* in the presence of teeth at the distal end of the upper margin of the rostrum, but is readily distinguished by the absence of the branchiostegal spine and the greater length of the carpus of the second peraeopods.

The specimens in the Indian Museum are from the following localities:—

$\frac{9570}{10}$	R. Ganges, Mirzapur, United Provinces	R. B. S. Sewell.	Many.
			TYPES.
$\frac{9573}{10}$	Podhua Nala, Rajmahal, Bengal ...	B. L. Chaudhuri.	Two.

¹ I have seen a single specimen without any dorsal teeth on the distal part of the rostrum.

² Of forty specimens four have 3 ventral teeth, twenty-nine have 4 and seven have 5.

$\frac{9.577}{10}$	Kanaigunge, Backergunge Dist., Bengal	H. E. Stapleton.	Six.
$\frac{9.578}{10}$	R. Hughli, Calcutta	?	Several.
$\frac{9.575}{10}$	Dhappa, near Calcutta	S. Kemp.	Many.
$\frac{9.574}{10}$	Chingrighatta, near Calcutta	Mus. staff.	One.
$\frac{9.579}{10}$	Karnaphuli R., Rangamati, Chittagong Hill Tracts	Mus. collr.	Eight.
$\frac{9.571}{10}$	Pazudaung and Dala Creeks, Rangoon, Burma	N. Annandale.	Many.
$\frac{9.576}{10}$	Moulmein R., Burma.	'Investigator.'	Three.
$\frac{9.572}{10}$	Gying R., nr. Moulmein, Burma	N. Annandale.	Several.

The species occurs in water that is quite fresh as well as in that of low salinity. At Chingrighatta it was obtained in water of specific gravity 1.0015 and it is evidently not uncommon in the Gangetic delta, occurring also in the estuaries of the Sitaung and Moulmein rivers in Burma. It has, however, been taken at places far remote from tidal influence. Rajmahal is some 350 miles by river from the sea, while Mirzapur in the United Provinces is 700 miles by river from the coast and nearly 400 miles in a direct line from the sea.

Leander potamiscus, sp. nov.

This species resembles *L. fluminicola* in the absence of the branchiostegal spine and in the great length of the carpus of the second peraeopods; it may be distinguished by the following characters:—

(i) The rostrum is longer, extending beyond the tip of the antennal scale by two fifths or one half of its length. The basal crest is low and bears from 7 to 10 teeth,¹ the hindmost being situated on the carapace behind the level of the orbit. On the upper side of the apex there are from 1 to 3 small teeth, usually 2, and there is not infrequently an additional tooth between these and the foremost of those that form the basal crest. The teeth on the lower margin are more numerous, from 6 to 10² (text-fig. 7).

(ii) The finely-cut longitudinal groove on the carapace, just above the position usually occupied by the branchiostegal spine, is particularly well defined.

(iii) The peraeopods are all more slender. The first pair reaches about to the end of the antennal scale, the carpus being two and a quarter or two and a half times the length of the chela.

(iv) The second peraeopods reach beyond the scale by the chela and a portion (sometimes as much as one third the length) of the carpus. The chela is one fifth shorter than the ischium and about one half (sometimes a little more, sometimes a little

¹ Of twenty-two specimens five have 7 teeth on the basal crest, twelve have 8, four have 9 and one has 10.

² Of twenty-two specimens one has 6 inferior teeth, five have 7, ten have 8, five have 9 and one has 10.

less) the length of the carpus. The fingers are not markedly spooned and are much shorter than in *L. fluminicola*, scarcely more than two thirds the length of the palm.

(v) The last three pereopods are very long and slender. The third pair reach beyond the antennal scale by more than the length of the dactylus, the fifth by the dactylus and one half or two thirds the length of the propodus. The dactylus in all three pairs is very short. In the fifth pair the dactylus is considerably less than half the length of the carpus; the propodus is twice the length of the carpus and about one-sixth longer than the merus.

(vi) The spinules on the upper surface of the telson are rather differently placed. In *L. fluminicola* the first pair is placed behind the middle of the telson, and the second pair is little if at all nearer

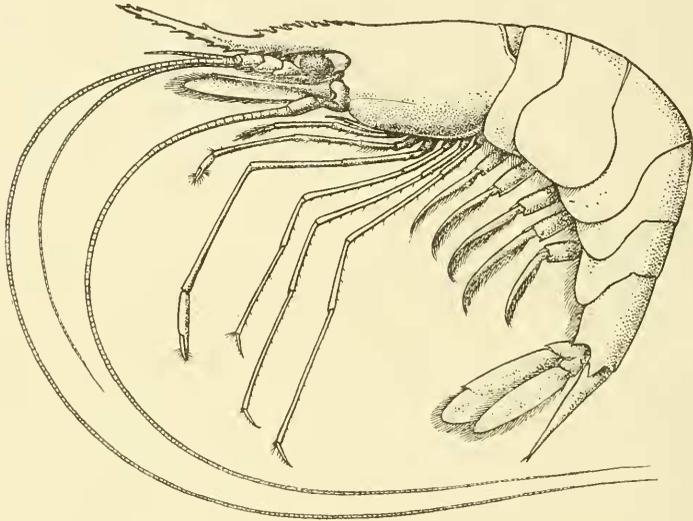


FIG. 7.—*Leander potamiscus*, sp. nov.

to the first than to the tip. In *L. potamiscus* the first pair is almost in the middle of the telson and the second is placed much in advance of a point midway between the first pair and the tip.

In all other respects *L. potamiscus* bears the closest resemblance to *L. fluminicola*. The antennules and antennal scale are almost exactly similar. The first maxillipede is nearly the same as in Sollaud's figure of *L. mani*, the distal lobe of the epipod being more sharply pointed than in other species. The spines at the tip of the telson are rather longer than in allied forms.

Large specimens reach a total length of about 48 mm. The eggs borne by ovigerous females are small, about 0.54 × 0.44 mm. in longer and shorter diameter.

Dr. Annandale notes that most of the specimens he collected, were practically colourless when alive, though not transparent.

A few of the largest, however, probably adult males, had several longitudinal black lines on each side of the carapace which converged forwards slightly. They had also a small black spot on the side of each abdominal somite. The fingers of the second legs were scarlet and the palms of the chelae opaque shining white; there were also opaque shining white spots on the other segments of the chelae.

The specimens collected by Dr. Annandale were caught in February 1916, in the Patani River, below the town of Patani in the Siamese Malay States and at Telok Tikus on Penang Island in a small stream near the sea. A number of other examples¹ are in the Indian Museum, obtained by Col. C. G. Rogers in a small creek at the south-eastern corner of Middle I. in the Andamans. The largest of these specimens is 38 mm. in length, the collection, which was made in April 1911 not comprising any ovigerous females. In all three localities the specimens were found in fresh water, the situation in which they were taken being, however, subject to tidal influence.

The type specimens, from the Patani River, bear the number 9552/10 in the register of the Zoological Survey.

Palaemon mirabilis, sp. nov.

(Plate x.)

A very remarkable Palaemonid, represented in the Indian Museum by a number of specimens from the Rangoon and Moulmein Rivers and from various localities in the Gangetic delta, apparently belongs to a species hitherto undescribed. In the peculiar form of the rostrum and the extreme slenderness of the legs the species differs widely from typical members of the genus *Palaemon* and bears a curious and perhaps significant resemblance to *Leander styliferus*.

The rostrum is short and does not quite reach the end of the antennular peduncle. On the upper side of the lateral carina it consists of a thin lamella—in height greatly exceeding that of any other species of *Palaemon* known to me—with a strongly convex

¹ Since the above account was written I have obtained about thirty-five additional specimens of *L. potamiscus* in Portuguese India. A number were found in the Sanguem R. at Sanvorden and one, presented by Capt. F. de Vasconcellos, was taken in the Tuari R. near Cortalim. These records, being from the west coast of India, indicate a considerable extension in the known range of the species. The specimens agree closely with the types, but possess on the whole fewer rostral teeth; on the upper margin at the base there are 7 or 8, rarely 9, and on the lower margin only 6 or 7. In the single individual from the Tuari R. the basal crest is composed of 6 teeth, while there are 8 on the lower margin. The specimens differ from *L. fluminicola* in all the points noted above. When living they were semi-transparent, with a few very small chromatophores scattered on the body; the rostrum in front of the basal crest was deeply pigmented. The colouration thus differs conspicuously from that noted by Dr. Annandale in the case of large Patani R. examples. As in the case of the other records, the specimens from Portuguese India were found in fresh water, but in places subject to tidal influence. A number of individuals harbour Bopyrid parasites.

upper border bearing many close-set teeth. The rostrum begins as a carina in the middle of the carapace and its upper border is sharply ascendant up to a point immediately over the eye; in front of this it drops steeply to the apex, which is straight, narrow and produced. The margin between the highest point and the apex is concave. The teeth on the upper border vary in number from 13 to 16,¹ of which from 4 to 6 (usually 4 or 5) are situated on the carapace behind the level of the orbit. The teeth are fixed and evenly spaced and the interstices between them are filled with hairs. The lower margin is convex, but is not greatly expanded: the depth of the inferior portion of the blade is considerably less than half the depth of the upper portion. The lower margin bears 1, very rarely 2 teeth² in the distal half of its length.

The carapace is smooth. The antennal tooth is well-formed and from its base a strong carina runs backwards and downwards to the base of the hepatic tooth. The latter is large and beneath and behind it there is a shallow groove. A depression defines the upper posterior limits of the branchial region and there is a faint longitudinal groove on either side of the cardiac area.

The eye is short and somewhat depressed. The "ocellus" is rather large and is broadly in contact with the cornea (pl. x, fig. a).

The antennular peduncle does not differ materially from that of typical *Palaemon*. The basal segment is rather slender and the keel near the inner edge of its lower surface bears the customary tooth in its proximal half; the outer margin terminates anteriorly in a sharp tooth extending far beyond the produced lateral portions of the segment. The second segment is less than two thirds the length of the third. The accessory flagellum is conspicuously serrate externally and is about as long as the peduncle; it is fused basally with the outer branch for a distance not equal to half the length of the last peduncular segment.

The antennal scale (pl. x, fig. b) is about three times as long as wide. Its outer margin is straight and ends in a sharp tooth which does not reach nearly as far forwards as the apical portion of the lamella.

The oral appendages do not appear to differ in any noteworthy feature from those of *Palaemon* or *Leander*. The mandible bears a three-segmented palp, the last segment being almost as long as the two basal ones combined; the incisor-process ends in three large teeth. In the second maxilla the two lobes that form the distal lacinia are rather narrower than is usual. The first maxillipedes possess a bilobed epipod and the second an epipod with a podobranch attached. The third maxillipedes reach about to the middle of the antennal scale. The exopod

¹ Of fifty specimens five have 13 dorsal teeth, thirteen have 14, twenty-three have 15 and nine have 16.

² Of fifty specimens forty-eight have a single ventral tooth, while two have 2 teeth.

extends nearly to the end of the antepenultimate segment, which is conspicuously flattened and dilated distally; the terminal segment is about three quarters the length of the penultimate.

The first peraeopods reach the tip of the antennal scale. The carpus is rather less than twice the length of the chela; the fingers bear tufts of setae and are a little longer than the palm.

The second peraeopods reach beyond the end of the scale by the length of the chela and are equal and equally long in both sexes. The merus is a shade longer than the ischium and is about one and a quarter times the length of the carpus. The chela is rather more than one and a half times the length of the carpus and the palm is about two thirds the length of the fingers. The whole limb bears a singularly close resemblance to that of *Leander styliferus* and differs widely in form from that of typical *Palaemon*. The basal segments are all slender: the carpus is broadened distally where it is fully one and a half times as thick as at its proximal end; the palm is strongly inflated and much broader than the carpus, while each of the fingers is very slender, slightly curved and with an inturred claw at the apex (pl. x, fig. c). The fingers meet throughout their length when the chela is closed and are without teeth on their inner margins. The entire limb is glabrous except for a few fine and sparsely distributed hairs on the fingers.

The last three pairs of peraeopods are very slender and increase successively in length to a notable extent. The third pair reaches beyond the tip of the antennal scale by the length of the dactylus, the fourth by the dactylus and the greater part of the propodus, the fifth by the dactylus, propodus and a small portion of the carpus. The fifth leg is more than twice the length of the carapace and rostrum combined. In the third pair the carpus and dactylus are about equal in length; the propodus is nearly two and a half times as long and is a little shorter than the merus. In the fifth pair, which is excessively slender, the carpus is a good deal more than twice the length of the dactylus. The propodus is twice the length of the carpus and is one and a fifth times as long as the merus. Two or three pairs of microscopic spinules may usually be found on the propodi of the third and fourth pairs and a series of similar but more closely-set spinules at the distal end of the same segment in the fifth pair. In all three the upper surface of the dactylus is setose (pl. x, fig. d).

The abdomen is smooth. In adults the sixth somite, measured dorsally, is about one and a half times the length of the fifth; in young examples it is rather longer. The telson is much shorter than the inner uropod; it is smoothly rounded above and generally bears two pairs of minute dorsal spinules. The apex is very narrow and consists of a small median point flanked by a pair of spinules. Those of the inner pair are long and between them there are two plumose setae; those of the outer pair are quite short (pl. x, fig. e).

Large specimens reach a length of about 55 mm. from the tip of the rostrum to the apex of the telson. The eggs borne by

the females are small, about 0.56 mm. by 0.43 mm. in longer and shorter diameter.

Living specimens are transparent, the dark gastric and hepatic masses being as a rule clearly visible through the carapace. In large individuals reddish flecks and suffusions are sometimes found on the sides of the abdomen and the postero-dorsal margin of each somite is rather deeply tinged with the same colour. The eggs are pale greenish yellow. Small specimens are quite colourless.

This remarkable species shows in a new and very striking manner the close relation that exists between the genera *Leander* and *Palaemon*, and once again awakens doubts as to whether our classification is correct.

The only essential difference between the two genera rests in the hepatic spine, which is present in *Palaemon* and absent in *Leander*, and, in comparing normal forms of the latter genus with species of *Palaemon* in which the chelipedes of the male have not assumed a peculiar development, it is frequently by this point alone that the two genera can be distinguished. The value of the character has recently been much discounted by Calman's discovery that it is not, as was previously thought, absolutely constant.¹ In *Palaemon hildebrandti*, a form which is restricted to Madagascar, the hepatic tooth may be either present or absent. In all other respects this species is a typical *Palaemon*; it shows no affinity with *Leander* and cannot be regarded as establishing a link between the two genera. It indicates none the less that the hepatic tooth may occasionally prove an unreliable factor.

The existence of such a form as *Palaemon mirabilis* is both unexpected and perplexing, for, except for the presence of the hepatic tooth, its affinities seem to be unmistakably with *Leander styliiferus* and its allies, a group of species which form an outstanding and apparently highly specialized section of the genus. Were it not for the tooth in question *P. mirabilis* would undoubtedly be given a place in this section of *Leander*, differing from *L. styliiferus* merely in the abrupt curtailment of the rostrum and in the proportionate length of the various segments of the legs. Moreover, so far as I am aware, the species bears no resemblance to any *Palaemon* hitherto described.

We see, therefore, that if the character of the hepatic tooth be upheld as a generic determinant, a double relationship can be traced between the two genera: firstly, through the unspecialized forms of each and secondly,—if my interpretation of the facts be correct—between *Palaemon mirabilis* and the specialized *Leander* of the *styliiferus*-group. If these relationships are accepted as indications of the course which evolution has taken, as I think they must be, we are forced to admit the existence of a double line of descent—which is manifestly impossible in a rational scheme of classification. It should be noted that the *styliiferus*-group does not appear to be a disconnected entity, such as might have evolved

¹ Calman, *Proc. Zool. Soc. London*, 1913, p. 928.

independently from some such form as *P. mirabilis*; on the contrary, it seems to grade evenly into the more normal species of *Leander* through such forms as *L. concinnus*.

Following the classification at present in vogue, I have described the species as a member of the genus *Palaemon*, though, as already pointed out, it then becomes extremely difficult to explain how the different forms have evolved. The facts of the case, in my opinion, almost compel one to regard *P. mirabilis* as a true *Leander* and lead to the conclusion that, whereas the hepatic tooth in *Palaemon hildebrandti* has sometimes become suppressed, it has actually *reappeared* in a specialized member of the related genus. My only excuse for not at once referring the species to the genus *Leander* is that I believe it unwise to alter accepted classification on theory alone, unless such theory be extremely well founded. At present, unfortunately, our knowledge of the classification and affinities of the genera of Palaemonidae is very incomplete; it may well be that further investigation will throw light on the position of the species here described.

The specimens in the Indian Museum are from the following localities:—

$\frac{9633.5}{10}$	Pazudaung and Dala Creeks, Rangoon	N. Annandale.	Sixty-five.
$\frac{9431}{10}$	Moulmein R., Burma ...	'Investigator.'	Nineteen.
$\frac{9636}{10}$	Off Cowcolly Lighthouse, Hughli R.	J. Munro.	Six.
$\frac{9638}{10}$	Trebeni, Hughli dist. ...	B. L. Chaudhuri.	Many young.
$\frac{9637}{10}$	Sandheads, Gangetic delta ...	J. Wood-Mason.	One.
$\frac{9721}{10}$	R. Hughli, Sibpur, Calcutta ...	S. Kemp.	Many.
$\frac{9725}{10}$	Matlah R., Port Canning, Gangetic delta	S. Kemp.	Several.
$\frac{9639}{10}$	Hughli Nullah, Bosondherabad, Gangetic delta	J. T. Jenkins.	One.
$\frac{9641}{10}$	Mouth of Damodar R., Gangetic delta	T. Southwell.	Three.
$\frac{9726}{10}$	Near Shela, Khulna dist., Gangetic delta	J. T. Jenkins.	Four.
$\frac{9640}{10}$	Creek nr. Barisal, Backergunge dist.	T. Southwell.	One.

In all these localities the water is brackish, either permanently or at certain states of the tide. The type specimens are from Rangoon and bear the number 9633/10 in the register of the Zoological Survey.